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RESTRICTED CIRCULATION

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AGRICULTURAL MEMORANDUM NO.363

Estimating bean harvesting days from meteorological data.

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1. Introduction

There is a suggestion of growing dwarf French beans on contract on a farm in the West Midlands. We were asked to provide an estimate of the number of days per year when harvesting (with a heavy machine) would not be possible.

The soil is described as a fairly stiff clay, and the farm is very close to Drayton EHF. We were asked to consider a crop sown in early May for harvest during August and also a crop sown in early June for a September harvest.

2. Method

The problem was considered in two parts.

2.1 Soil Moisture. It was assumed that heavy machinery could not be used when the soil was at field capacity during the harvest period.

2.2 Moisture on Plant. It is unlikely that the crop can be harvested when the plants are wet.

3. Soil Moisture

3.1 Data used: Daily rainfall for Drayton EHF for April to September 1951-70.
: Estimated potential transpiration for SE Warwickshire.

3.2 The moisture status of the soil on 1 August each year, when harvesting begins, was determined by compiling a half-monthly water balance sheet as described in MAFF Technical Bulletin No.16. The following assumptions were made:

i The soil was at field capacity on 1 April

ii No substantial irrigation was envisaged

iii Crop sown 1 May
25% cover 15 June
50% cover 30 June

iv During the period 1 April to 15 June, transpiration at half the potential rate was assumed, subject to a maximum soil moisture deficit of 0.75 inch.

v During the period 15-30 June transpiration was assumed at half the potential rate, with no restriction on the SMD.

vi During the period 1-31 July full transpiration was assumed with no restrictions other than those of available moisture described in the Bulletin.

3.3 An example is given for 1954 to illustrate the method. (Table I)

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3.4 During the harvest period 1-31 August a daily water balance sheet was constructed assuming that the potential transpiration for the month was divided equally between the days. By inspection of the first column (0-2") the number of days when the soil was returned to field capacity was determined.

An example is given for 1954 in Table II.

3.5 Similar computations were made for a crop sown on 1 June to be harvested from 1-30 September with corresponding adjustments to the dates given in 3.2.

4. Moisture on Plant

Wet plants cannot easily be harvested by machine. Daily rainfall during the harvest month (August or September) was examined using the following criteria to determine non-harvest days.

i Daily rainfall .03 to .24 inch prevents harvest on that day

ii Daily rainfall $\geq$ .25 inch prevents harvest on that day and the following day.

5. Summary and discussion of results

Table III gives the number of non-harvest days based on the criteria in 2.1 and in 4.

The main restriction on machine harvesting dwarf French beans in August or September is clearly water on the plant. Since the estimated daily transpiration rate in either month is greater than the lower limit of daily rainfall (.03 inch) the values in Table III given under Moisture on Plant include those given under Soil Moisture.

The criteria used are open to question, particularly those used in relation to plant wetness. We would welcome suggestions for their revision, particularly when these are based on experience of harvesting this crop.

Any comments or suggestions on this paper should be sent to the authors.

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TABLE I Water Balance Sheet - DRAYTON August Harvest 1954

Period	Available Moisture			Rain	Transpiration		Gain to Soil	Loss to Soil	Excess Water
	0-2"	2-4"	4-5"		Potential	Actual			
1-15 April	2.0	2.0	1.0	.23	1.25	.63		.40	
16-30 April	1.60	2.0	1.0	.33	1.30	.65		.32	
1-15 May	1.28	2.0	1.0	.91	1.35	.68	.23		
16-31 May	1.51	2.0	1.0	.98	1.35	.68	.30		
1-15 June	1.81	2.0	1.0	2.01	1.60	.80	.19		1.02
16-30 June	2.0	2.0	1.0	.24	1.60	.80		.56	
1-15 July	1.44	2.0	1.0	1.22	1.70	1.70		.48	
16-31 July	0.96	2.0	1.0	2.03	1.70	1.70	.33		
Final state	1.29	2.0	1.0						

TABLE II Daily Water Balance Sheet - DRAYTON August Harvest 1954

PT = 2.60 = .08 per day but .09 on 12 days

Period	Available Moisture			Rain	Transpiration		Gain to Soil	Loss to Soil	Excess Water
	0-2"	2-4"	4-5"		Potential	Actual			
1	1.29	2.0	1.0	-	.09	.09		.09	
2	1.20			.24	.09	.09	.15		
3	1.35			.12	.08	.08	.04		
4	1.39			.03	.09	.09		.06	
5	1.33			-	.08	.08		.08	
6	1.25			.38	.08	.08	.30		
7	1.55			.06	.09	.09		.03	
8	1.52			.19	.08	.08	.11		
9	1.63			.47	.08	.08	.37		.02
10	2.00			.24	.09	.09			.15
11	2.00			.03	.08	.08		.05	
12	1.95			.23	.08	.08	.05		.10
13	2.00			.12	.09	.09			.03
14	2.00			-	.08	.08		.08	
15	1.92			.04	.08	.08		.04	
16	1.88			.14	.09	.09	.05		
17	1.93			-	.08	.08		.08	
18	1.85			.45	.08	.08	.15		.22
19	2.00			.03	.09	.09		.06	
20	1.94			.22	.08	.08	.06		.08
21	2.00			.57	.08	.08			.49
22	2.00			-	.09	.09		.09	
23	1.91			.01	.08	.08		.07	
24	1.84			.13	.08	.08	.05		
25	1.89			-	.09	.09		.09	
26	1.80			-	.08	.08		.08	
27	1.72			-	.08	.08		.08	
28	1.64			-	.09	.09		.09	
29	1.55			-	.08	.08		.08	
30	1.47			-	.08	.08		.08	
31	1.39	2.0	1.0	-	.09	.09		.09	
Final state	1.30	2.0	1.0						

Note that soil at Field Capacity on only 7 days
Note that the available moisture in the 2-4" and 4-5" ranges remains unchanged throughout the month

TABLE III Non-harvest days - DRAYTON

Year	Soil Moisture		Moisture on Plant	
	Aug	Sept	Aug	Sept
1951	0	3	21	13
2	4	0	14	12
3	1	7	12	13
4	7	0	19	15
5	0	0	7	7
6	1	5	25	10
7	1	5	14	15
8	0	7	17	18
9	0	0	8	2
1960	1	6	20	16
1	0	0	10	12
2	3	1	14	13
3	0	0	13	8
4	0	0	7	4
5	1	2	14	15
6	1	1	12	7
7	0	0	10	20
8	0	10	11	19
9	4	0	15	4
1970	2	4	13	12
Totals	26	51	276	235
Means	1.3	2.5	13.8	11.8
Range	0-7	0-10	7-25	2-20